SUBJECT: Soil Boring and Monitor Well Installation

When the Texas Natural Resource Conservation Commission (TNRCC) is notified of a release from a storage tank, the TNRCC may request that the owner or operator of the leaking storage tank(s) conduct an environmental site assessment to determine the extent of the effect of the release upon the environment. The requested environmental site assessment generally requires the installation of soil borings to investigate the effect of the release upon the soils and in some cases the installation of monitor wells to investigate the effect of the release upon the groundwater.

- **The TNRCC requires that the services of a registered Corrective Action Specialist (and a Project Manager as of February 4, 1994) be employed to conduct the requested assessment and to oversee the installation of the soil borings and monitor wells.**

This pamphlet details the minimum requirements for the installation of the requested soil borings and monitor wells. Monitor wells must be installed in compliance with Title 30, Texas Administrative Code, Chapter 338 which contains the specific Texas regulations regarding the installation of water wells and monitor wells. Of particular importance is the requirement that monitor wells must be installed within the State of Texas by a driller licensed by the State of Texas.

This pamphlet also provides some recommendations for soil boring/monitor well design and placement.

Soil Boring Installation

Soil borings are utilized to collect soil and/or rock samples from below the ground surface. The collected samples are used to determine:

- the type of soil and/or rock present beneath the site, and
- the amount of and the limits of any contamination in the soil resulting from the release from the storage tank. Contaminant levels are determined through laboratory analysis of soil samples.

The TNRCC recommends that three soil borings be initially installed during the first phase of an environmental site assessment in order to determine:

- the degree or amount of contamination in the soil,
- the lateral or horizontal extent of contamination in the soil, and
- the vertical extent or depth of contamination in the soil.

When possible, the soil borings should be installed using the hollow-stem auger method in order to avoid the use of drilling fluids and to make it easier to collect representative soil samples. The use of the hollow-stem auger method also makes the subsequent installation of monitor wells easier.

In order to prevent the spread of contamination from one boring to another (cross-contamination), all downhole drilling equipment should be decontaminated between each boring. Sampling equipment should be decontaminated using tri-sodium phosphate or a similar detergent after the collection of each sample.

Soil samples should be collected continuously to the bottom of each boring. Less frequent sampling may be allowable when deep borings (greater than 50 feet) are drilled.

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Samples should be collected with a decontaminated split-spoon sampler, Shelby tube, or similar sampling device. All collected soil samples should be viewed and described to document subsurface soil and rock types utilizing the Unified Soil Classification System.

Discreet, duplicate soil samples should be collected from the sampler referenced above. One sample should be field screened using an automated screening device to check for the presence of vapors from the contaminants released from the storage tank. The second sample should be immediately preserved for potential shipment to the laboratory for analysis.

Soil borings should be drilled to a depth of at least five feet below the base of contamination. While drilling, the presence of contaminants should be determined by field screening the collected soil samples.

If a groundwater producing zone is encountered during the drilling of a boring, consideration should be given to converting the boring to a monitor well. Monitor wells are needed to investigate groundwater contamination. Please refer to the subsequent Monitor Well Installation section.

The purpose of submitting soil samples for laboratory analysis is to determine the maximum level of soil contamination at a particular location and to determine the maximum depth of soil contamination at a particular location. Therefore, soil samples selected for laboratory analysis should be collected from the zone of highest contamination as determined from the field screen, *and* from one or more of the following:

- immediately above the water table or bedrock,
- the base of each borehole (if groundwater is not encountered), or
- below the water table if groundwater is encountered.

Generally, it is adequate that only two or three soil samples per boring are submitted for laboratory analysis. However, in certain instances more soil sample analyses may be needed. In such cases, contact the TNRCC case coordinator for approval.

Soil samples should be collected immediately after the sampling device is retrieved from the borehole to limit exposure of the sample to effects of wind and heat.

- Each sample should be collected using clean disposable gloves and other clean sampling utensils.
- Samples which are to be sent to the laboratory for analysis should be placed in sterile sample jars provided by the laboratory. Completely fill each sample jar so that no air space (headspace) exists, wipe soil from the jar threads, and seal the jar using a cap lined with Teflon. The jar should be labeled and placed on ice in a covered, insulated cooler and chilled to 40°F (4°C).

  Please refer to the TNRCC pamphlet entitled *Soil and Groundwater Sampling and Analysis* for the determination of which constituents to analyze for and which laboratory methods to use.

Monitor Well Installation

Monitor wells should be installed when groundwater is determined to be affected or thought to be affected by the release from the storage tank. Monitor wells are necessary to:

- determine the depth to groundwater at the site,
- determine the direction of groundwater flow, and
- collect representative groundwater samples for laboratory analysis to determine the degree of groundwater contamination and the quality of the groundwater.

If there is no evidence or threat of a groundwater impact, monitor wells are generally unnecessary. Evidence of groundwater impact may include:

- groundwater is present at a very shallow depth,
- groundwater is encountered while installing borings prior to reaching the base of soil contamination, or
- a neighboring water well is contaminated with the substance released from the storage tank in question.

In all cases, preparations should be made in advance so that monitor wells can be installed immediately after drilling the borings described in the Soil Boring Installation section of this pamphlet if wells become necessary.

If the depth to the first groundwater-producing zone is not known, it may be helpful to consult case files of existing LPST sites in the surrounding area to predict the depth of groundwater occurrence. Specific LPST case files can be requested through the TNRCC Records Services office at 512/908-2920.

For low-yield groundwater zones, groundwater may not immediately enter the well bore; it may be necessary to install a monitor well and monitor the well for the appearance of groundwater accumulation. During periods of drought it will be necessary to monitor a well for several seasons to determine whether a groundwater zone is present and if so, whether groundwater is impacted.

If monitor wells are needed, the TNRCC recommends that three monitor wells be installed initially. Monitor wells should be constructed of flush-threaded Schedule 40 PVC casing and factory slotted screen. The screen slots should not be greater than 0.02 inches in width and the casing diameter should be four inches or less. All wells should be fitted with O-rings to ensure water-tight joints, a lower end cap and an upper locking, water-tight cap, and be completed below grade with protective cover (Figure 1). The wells should be sealed and finished in accordance with specifications detailed in 30 TAC, Chapter 338.

Figure 1

Monitor wells must be designed such that the released contaminant is able to freely enter the well under static (undisturbed) conditions at all times. If the contaminant is a petroleum hydrocarbon, the contaminant will tend to float near the surface of the water table. Therefore, care must be taken to ensure that the well is not screened too far above or below the water table such as is illustrated in Figure 2.

Wells should be installed so that the screened interval intercepts the top of the groundwater zone (and the layer of floating product, if present). An example is shown in Figure 3. Wells which are not screened properly will be required to be replaced with new properly-screened wells.

Monitor well screen generally should extend to approximately ten feet below the water-table surface and five to ten feet above the water table. For confined conditions, the top of the screen may coincide with the top of the confined aquifer. In any event, the well should be designed and constructed such that the groundwater surface or product surface, if applicable, constantly intersects the screened interval of the well (Figure 4).

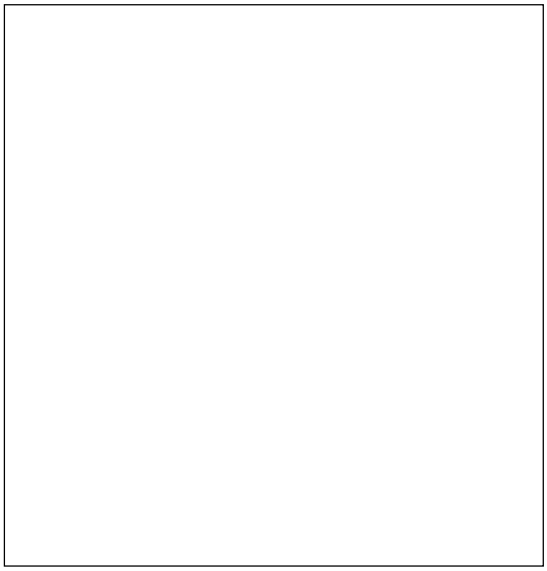

Figure 3

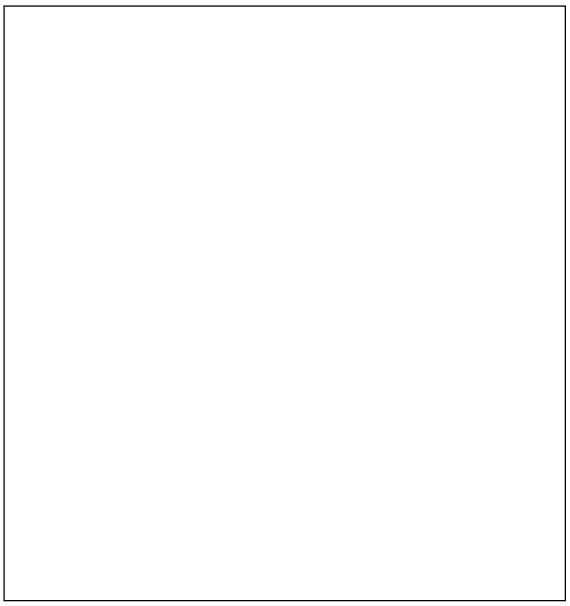

Figure 4

Deeper monitor wells may be necessary if the well will be converted to a recovery well and a screen set ten feet below the water table surface will not allow for proper pump placement or sufficient drawdown.

Following the installation of the monitor wells, the wells must be properly developed to remove sediment from the well screen and gravel or filter pack, and to promote the entry of groundwater into the well.

The top-of-casing elevation of each well casing should be surveyed to the nearest 0.01 foot to mean sea level or to an arbitrary datum. Subsequent to monitor well emplacement, but no sooner than 24 hours after well development, the static depth to groundwater should be measured. This information is necessary to determine the direction of groundwater flow. The depth to groundwater should be measured to the nearest 0.01 foot. After the monitor wells have been measured, the wells should be bailed or purged in preparation for sampling of the groundwater for laboratory analysis. Generally, groundwater samples should not be collected for laboratory analysis from wells which contain a phase-separated layer of the product released from the leaking tank. After collecting a sample from a well, the sampling equipment should be decontaminated before sampling the next well unless disposable or dedicated sampling equipment is used. Monitor wells should be sampled in order from least contaminated to most contaminated when possible.

Samples should be collected using clean, disposable gloves and other clean sampling equipment. Samples should be collected in sterilized sample jars and vials supplied by the laboratory. Sample jars and vials should be filled to the top so that no air space (headspace) is present. The samples should be sealed with Teflon lined caps with a septum, labeled, and subsequently placed on ice in a covered, insulated cooler and chilled to 40°F (4°C).

Special Note: Only groundwater samples collected from properly designed and constructed wells are considered acceptable by the TNRCC. Groundwater samples collected from open boreholes are **not** consid-

ered acceptable by the TNRCC. For the analytical methods required by the TNRCC, please refer to TNRCC pamphlet entitled *Soil and Groundwater Sampling and Analysis*.

Copies of signed State of Texas Well Reports (Form No. WWD-012) submitted to the Water Well Driller's Board by the licensed well driller should be provided for all installed monitor wells. When monitor wells are plugged or decommissioned, copies of the signed State of Texas Plugging Reports (Form No. WWD-009) submitted to the Water Well Driller's Board should also be provided to the appropriate PST personnel.

Soil Boring and Monitor Well Placement

The intent of the soil boring and monitor well installation program is to determine how severely the release(s) from the product storage tank(s) has/have contaminated the soil and groundwater and to determine how far the released product(s) has/have spread in the soil and groundwater. In order to meet these goals, the TNRCC recommends that three borings/monitor wells be initially installed.

One boring and subsequent monitor well (if needed) should routinely be placed in the immediate vicinity of the suspected location of the leak in order to determine the degree of contamination and the vertical extent of contamination.

It is recommended that the two remaining borings/monitor wells be positioned to triangulate around the suspected leak point or tank system in areas where contamination is most likely to determine the levels of soil and groundwater contamination in the downgradient and lateral directions. The wells can be used to determine the direction of groundwater movement (Figure 5).

If additional borings/monitor wells are installed in the Comprehensive Site Assessment phase, it is recommended that the remaining borings/monitor wells be installed around the suspected leak point in a configuration suitable for assessing the upgradient, downgradient, and lateral concentration of soil and groundwater contamination, and the direction of groundwater movement (Figures 6 and 7).

The exact location of each monitor well should be determined by a qualified environmental consultant. The specific site characteristics, structural constraints, and the circumstances regarding the release should be considered in locating monitor wells.

If the installed borings/monitor wells do not delineate the extent of soil and/or groundwater contamination, additional borings and/or monitor wells may be requested by the TNRCC. Usually, more than one phase of boring/monitor well installation is necessary to completely define the extent of contamination. If additional borings and/or monitor wells are requested, the additional borings/monitor wells should generally be installed beyond the existing borings and/or monitor wells which are contaminated. If the plume has migrated offsite, it will be necessary to obtain permission from the property owner to install a monitor well. Because access agreements may require a considerable period of time, it is advised to start seeking access as soon as offsite migration is suspected.

Phase-Separated Product Removal

If a phase-separated product accumulation or layer is encountered within the soil during drilling or is present on top of the groundwater surface within a monitor well, immediate actions should be taken to collect and remove the product. It may be necessary to convert borings which encounter product or soil saturated with product to wells in order to allow for removal of the product over time. The removal of the product from the wells may involve periodic bailing or pumping. In other instances, the installation of an automated recovery system for continuous product removal may be necessary. The amount of removed product should be recorded and reported to the TNRCC on the *Monthly Product Recovery Report*.

Waste Disposition

The disposal of all contaminated drill cuttings, contaminated water, excavated soils, and other wastes must be documented and reported to the TNRCC, and treated or disposed in compliance with all applicable local, state, and federal laws.

Additional Information Please refer to the *Limited Site Assessment Guidance Document* and the other TNRCC pamphlets referred to in this document for additional information on boring and monitor well installations.	**Special Note:** Figures 1 - 4 are from American Petroleum Institute Publication 1628, Second Edition, August 1989.

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On September 1, 1993, the Texas Water Commission and the Texas Air Control Board merged to form the Texas Natural Resource Conservation Commission (TNRCC).